

We claim:

1. A microfluidic device comprising:
 - 2 a main flow path comprising a detection zone and an outlet; and
 - 3 at least two inlet flow paths wherein the inlet flow paths intersect and merge
 - 4 into the main flow path at or upstream of the detection zone at an upstream angle of
 - 5 less than 90°.
- 1 2. The microfluidic device of Claim 1 further comprising two inlet flow
- paths.
- 1 3. The microfluidic device of Claim 1 further comprising three inlet flow
- paths.
- 1 4. The microfluidic device of Claim 3 wherein the main flow path has at
- least one detection zone at or downstream of each intersection of each inlet flow path
- with the main flow path.
- 1 5. The microfluidic device of Claim 1 wherein the main flow path is from
- about 0.1 μm deep by 0.1 μm wide to about 1 mm deep by 2 mm wide.
- 1 6. The microfluidic device of Claim 1 wherein the first inlet flow path is
- from about 0.1 μm deep by 0.1 μm wide to about 1 mm deep by 2 mm wide.
- 1 7. The microfluidic device of Claim 1 further comprising means for
- applying a flow inducing force.
- 1 8. The microfluidic device of Claim 6 wherein the flow inducing force is
- electricity.

1 9. The microfluidic device of Claim 6 wherein the flow inducing force is
2 negative or positive fluid pressure.

1 10. The microfluidic device of Claim 9 wherein positive or negative
2 pressure is applied to the outlet.

1 11. The microfluidic device of Claim 1 wherein the device further
2 comprises cells in at least one of the inlet flow paths and the main flow path.

1 12. The microfluidic device of Claim 1 wherein the device further
2 comprises leukocytes, a calcium dye and a candidate compound in the main flow path.

1 13. An observation device comprising a plurality of microfluidic devices of
2 Claim 1 sharing a common detection zone.

1 14. The observation device of Claim 13, wherein the main flow paths of
2 the microfluidic devices are substantially parallel at the common detection zone.

1 15. An observation device comprising a plurality of microfluidic devices of
2 Claim 1 wherein the main flow paths of the microfluidic devices are substantially
3 parallel at their detection zones.

1 16. A method of observing the effect of a candidate compound on cells in a
2 microfluidic device comprising:

3 (a) providing a microfluidic device comprising a main flow path comprising a
4 detection zone, and an outlet and at least two inlet flow paths intersecting and merging
5 with the main flow path at or upstream of the detection zone;

6 (b) applying at least one cell to a first inlet flow path and the candidate
7 compound to a second inlet flow path;

8 (c) inducing flow of the cells and the candidate compound toward the outlet;
9 (d) allowing the cells to mix with the candidate compound at the intersection of
10 the second inlet flow path and the main flow path; and
11 (f) observing the effect of the candidate compound on the cells in the detection
12 zone.

1 17. The method of Claim 16 wherein the microfluidic device has three inlet
2 flow paths and a second candidate compound is added to the third inlet flow path.

1 18. The method of Claim 16 further comprising stopping the flow of the
2 cells while the cells are in the detection zone.

1 19. The method of Claim 17 further comprising observing the cells in each
2 of a number of detection zones wherein the main flow path comprises a plurality of
3 detection zones, wherein each detection zone is at or downstream of each intersection
4 of each inlet flow path with the main flow path.

1 20. The method of Claim 16 wherein the candidate compound being studied
2 is a cell activator and the cell is a lymphocyte.

1 21. The method of Claim 17 wherein cells are added to a first inlet flow
2 path, cell activator is added to a second inlet flow path, and a candidate compound is
3 added to a third inlet flow path.

1 22. The method of Claim 21 wherein the candidate compound being studied
2 is an inhibitor, and the cells are lymphocytes.

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1 ³ 23. The method of Claim ~~16~~ wherein the flow paths are coated with a
2 substance selected from the group consisting of proteins, glycoproteins, phospholipids,
3 hydrophilic polymers and hydrophobic polymers.

MUR 1 C2 7 A 24. The method of ~~Claim 23~~ wherein the flow path is coated with protein.

1 ⁵ 25. The method of ~~Claim 23~~ wherein the flow is induced by an electric
2 force.

1 ⁶ 26. The method of ~~Claim 24~~ wherein the flow is induced by positive or
2 negative fluid pressure.

1 27. A method for studying calcium influx in a lymphocyte comprising:
2 (a) providing a microfluidic device comprising a main flow path having a
3 detection zone, at least two inlet flow paths sequentially intersecting with the main
4 flow path upstream of the detection zone and an outlet downstream from the detection
5 zone;

6 (b) applying lymphocytes to a first inlet flow path and an activator to a second
7 inlet flow path;

8 (c) inducing flow of the lymphocytes and the activator toward the outlet;

9 (d) allowing the lymphocytes to mix with the activator at the intersection of the
10 second inlet flow path and the main flow path; and

11 (e) observing the effect of the activator on the lymphocytes in the detection
12 zone.

1 28. The method of Claim 27 wherein the microfluidic device comprises
2 three inlet flow paths further comprising adding a candidate compound to a third inlet
3 flow path; and observing the effect of the candidate compound on the lymphocytes in
4 the detection zone.

1 29. A method for studying leukocyte rolling comprising:
2 (a) providing a microfluidic device comprising a main flow path comprising a
3 detection zone and an outlet and at least two inlet flow paths sequentially intersecting
4 and merging with the main flow path at or upstream of the detection zone and wherein
5 the walls of the main flow path in the detection zone have attached thereto cell
6 adhesion molecules;
7 (b) applying at least one leukocyte to a first inlet flow path;
8 (c) applying a candidate compound to a second inlet flow path;
9 (d) inducing flow of the cells and the compound into the main flow path;
10 (d) allowing the leukocytes, candidate compound and cell adhesion molecules
11 to interact; and
12 (e) observing the leukocyte rolling in the detection zone.

1 30. The method of Claim 29 wherein the device comprises three inlet flow
2 paths, further comprising adding an inhibitor to said third inlet flow path; mixing the
3 inhibitor, leukocytes, candidate compound and cell adhesion molecules and observing
4 the leukocyte rolling in the detection zone.

1 31. The method of Claim 30 further comprising stopping the flow of the
2 cells, candidate compound and inhibitor during the mixing step.

1 32. The device of Claim 1 further comprising variations in the cross-section
2 of the main flow path.

1 33. The device of Claim 32 wherein the variations create a cell trapping
2 zone.

1 34. The device of Claim 33 wherein said variations are weirs.

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